

Purdue University

Purdue e-Pubs

Historical Documents of the Purdue
Cooperative Extension Service

Department of Agricultural Communication

3-1-1984

Water Resources & Rights: Emerging Issues

Charles A. Sargent

Follow this and additional works at: <https://docs.lib.purdue.edu/agext>

Sargent, Charles A., "Water Resources & Rights: Emerging Issues" (1984). *Historical Documents of the Purdue Cooperative Extension Service*. Paper 781.

<https://docs.lib.purdue.edu/agext/781>

For current publications, please contact the Education Store: <https://mdc.itap.purdue.edu/>

This document is provided for historical reference purposes only and should not be considered to be a practical reference or to contain information reflective of current understanding. For additional information, please contact the Department of Agricultural Communication at Purdue University, College of Agriculture: <http://www.ag.purdue.edu/agcomm>

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

EC-594
\$1.00

Adm
New
yes

A large, stylized splash of water in shades of gray, with several droplets falling from the bottom. The splash frames the central text.

WATER

RESOURCES & RIGHTS: EMERGING ISSUES

Historic Document

WATER RESOURCES & RIGHTS: EMERGING ISSUES

Charles A. Sargent, Department of Agricultural Economics, Purdue University

Acknowledgements: Special thanks to reviewers Melvin C. Poland; Cleon H. Foust, Professor of Law, Indiana University; William J. Andrews, Deputy Director, Indiana Department of Natural Resources; Dan Wiersman, former director of Water Research Council, Purdue; Chris Larson, Director of the Kankakee-Iroquois Regional Plan Commission; and Jack Nesbitt, Attorney, Rensselaer. Purdue University faculty reviewers included Martin Pond, Tom Hertel, Ron Wheaton, and Otto Doering.

INTRODUCTION

Water is becoming a major public policy issue in Indiana. Our relative abundance of high quality water gives us an advantage over water-short regions of the country in terms of economic development, agriculture, and our general quality of life. But real water problems are emerging as well: heavy use of ground water for irrigation has lowered water levels in specific areas of the state; energy production needs promise to drastically increase water consumption; water-short southern Indiana continues to require large interbasin transfers; and large cities are reaching out for water from surrounding areas. New and increasing demands for water will lead to greater competition and conflict over water rights and priorities.

Since we have very little water law on the books, huge investments are being made by public utilities, industry, and agriculture without a clear mandate on water rights and rules. Fortunately, however, water problems are being studied and discussed. Former Governor Otis R. Bowen set up a "Governor's Water Resource Study Commission" which produced an extensive report in 1980, with many suggestions for a "comprehensive water program." In 1982 legislation was passed in an attempt to alleviate the conflict over irrigation water withdrawals in Jasper and Newton counties. Also in 1982 a second

"Water Rights and Management Commission" developed draft legislation to create a new body of law built around a permit system to allocate water use. This publication draws heavily on the two commissions' work and on many other sources.

The report provides a brief background on our total water resource, as well as explains where we are in water law. Also, to emphasize the importance of definition as a means of ensuring a common understanding of terms pertaining to the issue of water rights and to underscore the need for continuing efforts in that direction, the report includes a list of definitions of existing terms. It then focuses on potential new demands for water. Different water management proposals are examined in relation to a few problem areas that are developing. Since many concerns relating to water cannot be covered in this brief publication, including recreational water uses, navigation, flooding, drainage, and water quality, the report limits discussion to the problems of irrigation, energy production, and areas short of water.

The purpose of this report is to contribute some useful information to the current discussion of water problems and opportunities, to help us move toward policies that will protect, conserve, and manage our common water resource, and provide a balance among competing uses for water.

I: EXISTING WATER RIGHTS TERMINOLOGY

Absolute ownership doctrine—doctrine which assumes that ground water is part of the land under which it is found and is the property of the overlying landowner.

Administrative-public management approach—approach to the water rights issue which involves the state's taking an active role in water management and assuming some degree of state-wide control.

Consumptive use—use in which the water is “used up” and not returned to its source.

Correlative rights doctrine—doctrine which assumes that owners of land over a common supply of ground water are entitled only to “reasonable use” of the underlying water, which must be shared according to some kind of allocation scheme.

Diffused surface water—water from falling rain or melting snow which spreads randomly over the ground with no definite banks or channels.

Ground water—water which occurs beneath the surface of the earth and is not confined.

Instream use—use which involves the utilization of surface water in place.

Non-consumptive use—use which returns substantial amounts of water to the source, essentially undiminished in volume, although perhaps changed in quality.

Property rights-institutional approach—approach to the water rights issue which involves making modifications in present law but stops short of a public management-allocation system.

Reasonable use riparian doctrine—doctrine which limits owners' riparian rights to uses and amounts that are “reasonable” under the circumstances.

Riparian rights doctrine—doctrine which gives owners of land abutting on bodies of water property rights to the adjacent water.

Surface water in water courses—surface water which flows along a definite course or channel, with a bed, banks, and sides.

Withdrawal use—use which involves the physical removal of water from its ground or surface source.

II: RESOURCES AND RIGHTS

Our Water Resources

Ecological Considerations. We have lots of water. Our earth contains about 326 million cubic miles of water, some on the surface, some as deep as 3 miles under the crust, and some as high as 7 miles in the atmosphere. More than 4.2 trillion gallons of water fall as rain, snow, sleet, or hail on the 48 contiguous states each day. That's about 20,000 gallons a day for each American, presumably more than enough to satisfy any need.

But it's not quite that simple. Over 99 percent of the Earth's vast water resource is of little use to us: it is either salty or locked up in polar ice caps. The valuable 1 percent moves as fresh water through the hydrologic cycle, from atmosphere to land and sea and back to the atmosphere. Our useful water comes from lakes and rivers, from soil moisture, or from underground porous rocks, called aquifers, all recharged by precipitation.

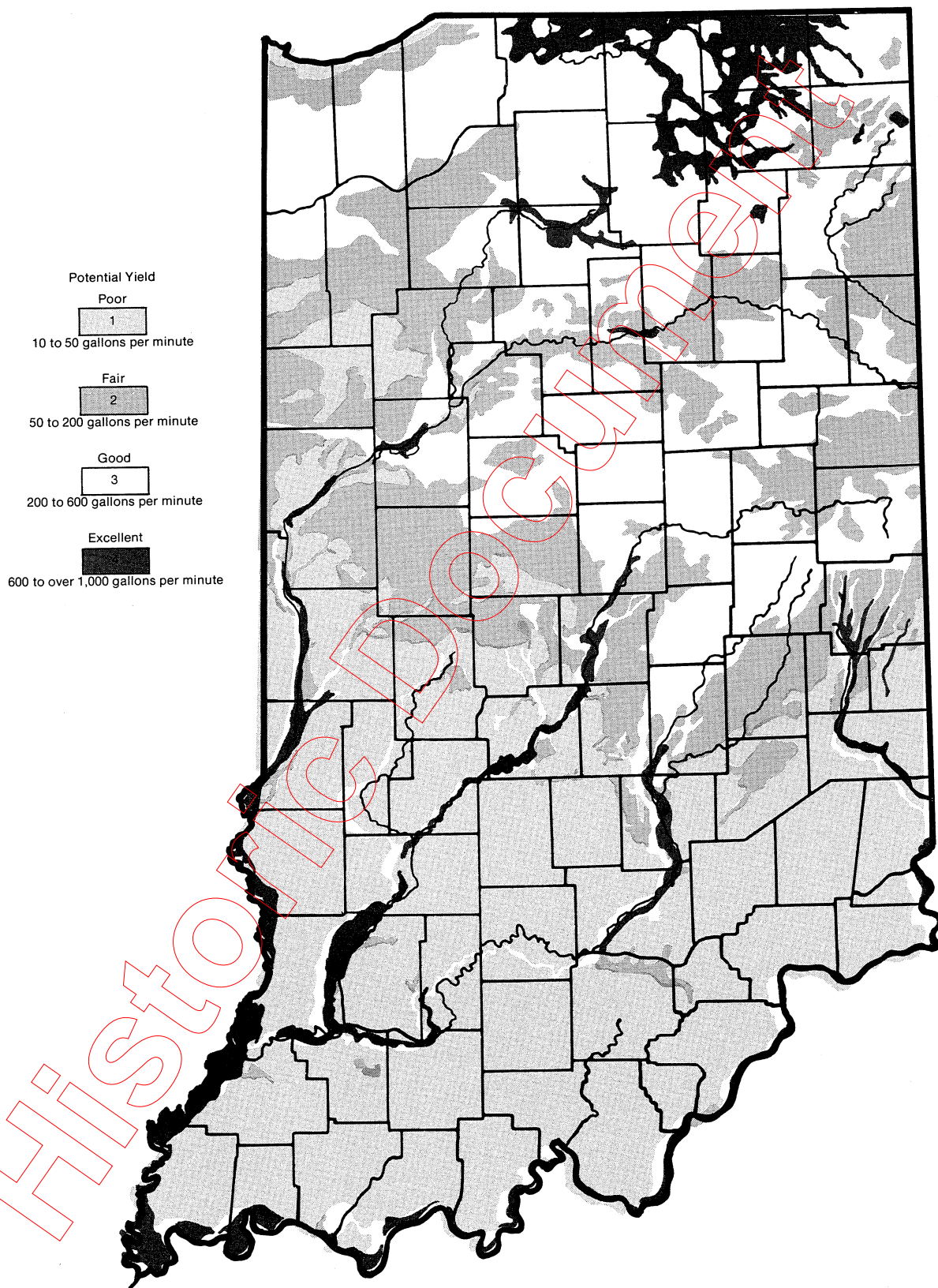
Indiana gets an average of 38 inches of water from the skies, with about 4 inches water equivalent in the form of snow. About 26 inches are lost immediately to evapotranspiration, leaving 12 inches to recharge surface and ground water supplies. About nine of these inches run off into rivers and lakes, with the remaining 3 inches percolating down into the ground. We utilize perhaps 10 percent of our renewable water resources.

Varied geological conditions within the state create some special water supply problems and opportunities. The northern third has many lakes, including one of the largest bodies of fresh water in the world: Lake Michigan. The area has excellent ground water resources, but highly permeable soil and flat terrain limit good surface impoundment sites. The middle third of the state has several major rivers and streams and fair to good ground water conditions. Southern Indiana has only spotty ground water supplies, often at great depths, but some large rivers are being tapped for water, and the impermeable subsoil makes ponds and reservoirs feasible in many locations. The southern border of the state is the Ohio River, one of the major waterways in the country.

Figure 1 shows that ground water capabilities vary widely in the state, ranging from as little as 10 gallons per minute (gpm) or less to over 2,000 gpm from properly constructed, large diameter wells penetrating the full thickness of the aquifer. There are 4 categories shown. Category 1 illustrates the poorest yielding areas, those whose wells usually yield less than 50 gpm and are often dry holes. Category 2 represents areas of fair yields of from 50 to 200 gpm, with less in some areas. Category 3 indicates those areas with good yields ranging from 200 to 600 gpm. Category 4 delineates excellent water bearing areas along major rivers and very productive aquifers in northern Indiana that can yield 600 to over 1,000 gpm.

Thus, while we have plenty of water, it is not always available at the right time, in the right place, in the right

Figure 1. Generalized Ground Water Availability in Indiana.



Source: Adapted from Governor's Water Resource Study Commission, 1980—as prepared by DNR.

amount, nor is it always of the desired quality. Water distribution and management is increasingly a problem.

Economic Considerations. Water is a unique resource when considered from an economic viewpoint. It is a "common property resource" or "public good" in the sense that it is free to be used by all, yet not really owned by anyone. The cost of water is only the expense of obtaining it from its natural source plus its transportation and possible treatment. It can be withdrawn and consumed in almost unlimited quantities at will, given rights of access, and the withdrawal is constrained only by the general limits imposed by the doctrine of "beneficial use."

The value of water varies with its specific use and availability. In drought conditions, small amounts are priceless as drinking water, while the larger amounts brought by flooding make water a valueless and destructive commodity. In times of water shortage, domestic use is commonly regarded as having priority over irrigation use. To the individual, then, water has a diminishing marginal value as the quantity supplied increases; that is, each succeeding unit is worth less by a small amount, regardless of how used.

When a resource is close to free and may be obtained in almost unlimited quantities, there is little incentive to use it efficiently. There are no strong market forces to encourage an economic allocation of the resource. Thus water can, in a sense, be "wasted." As long as the supply is practically unlimited, this poses few problems, but when competing uses strain existing supplies, efficient and equitable allocation becomes an issue.

Other factors can lead to an uneconomic use of water. In some cases water is appropriated prematurely and used excessively in an attempt to insure access rights. This is often called "grandfathering." Given the uncertainty over water rights, there is a tendency to exploit water sources in the hope of "beating out" future competitors for the water. This same insecurity of rights may lead to insecure investment in water facilities.

Water is frequently not priced in relationship to its cost or value in use, leading to wasteful consumption. This can become a problem, when and if water is not plentiful and "cheap." If water were priced in a traditional supply and demand market system instead of being "free," large consumptive users would be at a relative disadvantage compared to their current situation. If water became scarce and prices rose, uses like irrigation, water cooling, and some forms of energy production could lose out to more valuable and less consumptive uses.

We are using a limited system of common law to do some allocation of water, in the absence of a water market. Other states have experimented with taxation and fee systems for managing scarce water supplies, but without uniform success. The trend seems to be toward more comprehensive water management programs, administered by the state for local institutions, in order to allocate water among competing users and introduce some economic efficiency into the process. As long as

water is considered to be a public good, somewhat like air, it will be difficult to create a market system for it. But some progress can be made toward realistic pricing and economic valuation.

Water Rights

All life is dependent on water in its liquid form, and thus everyone has the "right" to water, the same as to air and space. Basic water rights evolved from the concept of water as common property, to assure its availability to all and to ensure that it was not the exclusive property of one person. Water became a "public good" in the economic sense, and every community made sure its inhabitants had access to water for consumption and for instream uses. Water became "common property" in the legal sense, "subject to right of use, only," and fell under the control of the state so that all citizens could make maximum, beneficial use of an essential resource.

As long as water was free for the taking and in abundant supply, law and property rights were of little concern. In the midwest, certain customs and common practice developed around water use that worked well without extensive rules and laws. Only in recent years have we felt the need to define property rights in water and begin to allocate water supplies. Thus we are moving from custom to law in water use, as competing uses call for some kind of water resource management. Regulation by custom is being replaced by regulation by law and institutions, particularly in the arid western states.

The minimal rules we do currently have evolved from a few court decisions and some legislative enactments. Early court cases decided in the late 1800's rested on interpretations of English common law doctrines and principles, with few major court tests since then. Legislation has vested some authority in state agencies, particularly the Department of Natural Resources and associated boards and commissions. Water rights and doctrines have developed somewhat differently for three broad classes of water in terms of location on the earth's surface. It is convenient to divide the discussion into 1. ground water; 2. surface water in a water course; and 3. diffused surface water. The first two categories are discussed here.

Ground Water Law

Ground water is defined as water that occurs beneath the surface of the earth and is not confined. Early court cases drew a distinction between underground water flowing in defined channels and water merely percolating at random. This distinction was probably not valid, and more recent legislation has classified ground water as "all water filling the natural openings under the earth's surface."

Two ground water doctrines evolved over time. The *absolute ownership doctrine* assumes ground water is part of the land under which it is found and is the property of the overlying landowner. He can make exclusive use of it if he chooses, even causing injury and loss to other

potential users, but stopping short of "malicious" use. The *correlative rights doctrine* holds that owners of land over a common supply of ground water are entitled only to "reasonable use" of underlying water and that it may be shared by others according to some kind of allocation scheme. We have modified the absolute ownership doctrine over time, but it is not clear just what general doctrine applies. Two appellate court cases in 1982 appear to contradict each other, and the Supreme Court may need to decide the issue. What does seem to emerge is the concept that water should be put to "reasonable and beneficial uses" by overlying land owners. Unlimited use has been stopped in certain circumstances. Legislation and court cases imply a strong, statewide protection policy, but provide little explanation of what constitutes "reasonable and beneficial use" of water, and little of what happens with competing uses of ground water. Nor is the issue of use of water on non-overlying lands addressed.

Surface Water in Water Courses

A *surface water course* is surface water flowing along a definite course or channel with a bed, banks, and sides. It includes rivers, streams, lakes, ponds, and marshes through which a water course flows. Indiana has adopted the *riparian rights doctrine* which gives owners of land abutting on bodies of water property rights to the adjacent water. Land bounding the water course thus becomes "riparian land," but it is uncertain how far riparian rights extend from the body of water and how much water can be used by the riparian land owner.

Two theories have emerged that help in part to define riparian rights. The natural flow theory adopted from English common law gives the land owner absolute right to use the "natural flow" of water along his property for "natural" purposes and a qualified right for "extraordinary" or "artificial" uses, but without diminution in quantity or alteration in quality. The reasonable use theory gives each riparian owner the right "to make a beneficial use of water for any purpose, provided such use does not unreasonably interfere with the beneficial uses of others." Indiana has essentially merged these two theories and has developed what can be called a *reasonable use-riparian doctrine* which limits the riparians' right to uses and amounts that are "reasonable" under the circumstances.

The application of the reasonable use doctrine has differed somewhat for various withdrawal uses. Judicial decisions and legislation have favored individual "domestic use" over other water uses; that is, water for household purposes and domestic animals has priority. Municipal water use has been considered "extraordinary," not domestic, and "can only be exercised reasonably and with regard to the rights of other proprietors." According to this doctrine, agricultural uses of surface water in water courses must be balanced against the reasonable needs of other riparians. Irrigation use has been questioned as a "reasonable use" of water when 1. it is in competition with

domestic use and 2. the water is used on non-riparian lands. There is no case law on industrial and commercial uses of surface water, but water rights here are probably similar to those of municipal water suppliers. Power and energy withdrawal uses, including water used for cooling purposes, have been considered "beneficial uses." Because of the massive amounts of water used in power generation, some balancing and limitations may be required to allow a sharing of water by other riparians.

Rights associated with withdrawal uses of surface water are different from those associated with instream uses. By *instream uses* we mean navigation, recreation (including fishing), waste disposal, and power generation. Instream uses do not involve withdrawal of water but can be considered consumptive when quality is changed, as in the case of waste disposal. Unlike the case of withdrawal rights, which are private rights arising out of land owned adjacent to water courses, instream users have both private and public rights. For example, the general public can use streams and rivers for fishing and boating, waste water can be put into streams by public waste treatment plants, and anyone can use designated navigable rivers for transportation and recreation. Even here riparian, domestic usage is given first priority, but after that, public and private rights are both considered and balanced to obtain the most "beneficial use."

The reader should recognize that there is a third major classification of water that will not be covered here. *Diffused surface water* is water from falling rains or melting snow which spreads randomly over the ground and has no definite banks or channel. In this category is found statutory and case law pertaining to flooding and drainage or, in other words, excess water.

There are many unanswered questions in the area of water rights. Essential terms such as "domestic use," "beneficial use," and "riparian lands" have not been precisely defined. There are few rules to help allocate water between competing uses. Interbasin transfers are being made without clear-cut authority. Investments in irrigation equipment, water utilities, and power plants are being made without any real assurance that access to the water will continue over time. Stream flows are not always protected and maintained for instream uses. Clearly, major water policy decisions will have to be made in the near future.

III: EMERGING ISSUES

Water demands have increased substantially over the years as Indiana's population has grown. Our overall supply of water is still adequate, but problems are occurring with specific water uses and in certain locations within the state. As water use goes up and the pattern of utilization changes, competing demands become harder to satisfy and water rights more critical.

As indicated earlier, it is convenient to divide the discussion of water rights and utilization into two broad categories: instream uses and withdrawal uses. Instream uses involve utilizing surface water in place, and do not involve ground water. *Withdrawal uses* involve the physical removal of water from its ground or surface source, and may be consumptive or non-consumptive in nature. *Consumptive uses* "use up" the water due to evaporation, incorporation into products or biological processes, or transferral to other locations, with the water not being returned to its source. *Non-consumptive uses* are those in which substantial amounts are returned to the source, essentially undiminished in volume, but perhaps changed in quality. In general, consumptive withdrawal uses are of the most concern.

Estimates of current and projected water withdrawal and consumption show considerable increases in consumption by the year 2000 across the state (see Table 1). Water consumption in future energy production will likely increase over four times current rates. Irrigation demand may almost double.

Water consumption in public water systems will not increase much, and rural water use (other than irrigation) will go up only modestly. However, both public water supply systems and rural water demands are already pressing against limited supplies in major urban areas and in southern Indiana, where ground water is scarce. Industry will consume perhaps 65 percent more in the year 2000, but much of this will be readily available to the big industrial complex in northwest Indiana from Lake Michigan and will be developed by the private sector.

The balance of this section will focus on irrigation, energy production, and specific water short areas of the state. The dimensions of the problem surrounding each issue are analyzed, and later new policy proposals are evaluated in terms of their possible impact on these major water resource issues.

Table 1. Current and Projected Water Withdrawals and Consumption in Million-Gallons-Per-Day, Indiana.

Water Use	1980		2000		Percent Increase in Consumption (1980-2000)
	Withdrawn	Consumed	Withdrawn	Consumed	
Public Water Supply	577.9	72.3	757.6	96.0	+ 38%
Industrial Self Supply	3,286.3	154.7	3,430.3	256.5	+ 65
Rural Water	155.4	155.4	209.4	209.4	+ 34
Irrigation*	260.4	234.4	501.7	451.6	+ 92
Energy Production**	9,502.0	89.0	5,044.5	385.0	+ 433

*Irrigation estimates on amount withdrawn have been changed from those in Study commission Report by original authors. Use is for only summer months.

**Includes water used for electrical power generation in present and future facilities, plus coal processing. Possible uses in processing oil shale, coal gasification and liquification are not included.

Source: Governor's Water Resource Study Commission Report, 1980, page 65.

Irrigation

Irrigation of agricultural crops consumes tremendous quantities of water, in fact the largest amount of any one use. This, despite the fact that Indiana irrigates fewer acres (approximately 90,000 in 1980) than many other states.

Irrigation is done on fairly high value crops grown on coarse-grained, well-drained soils, where the addition of water in the root zone can result in substantial yield increases. Irrigation is a seasonal water use, and the amount of water used varies with the amount and distribution of rainfall, as well as particular crop needs, soil characteristics, economic considerations such as pumping costs, and equipment expense. In Indiana irrigation is used to supplement rainfall, in contrast to western states that are often highly dependent on irrigation. Water comes from both ground and surface sources. Projections to the year 2000 estimate that about 157,000 acres will then be irrigated, much of it in northwestern and northern Indiana and some scattered areas across central and southwest Indiana where unique soils are found that respond to supplemental irrigation. As many as 838,000 acres have "economic potential" for irrigation.

Example of a Specific Problem. A significant problem with irrigation surfaced in the summer of 1981 in Newton and Jasper counties when a major corporation installed 30 irrigation wells and apparently caused the lowering of artesian water levels in an extensive limestone aquifer. Water levels in many wells used to supply households and farms in the area dropped to a point where their existing pumps could not reach it, resulting in a temporary loss of water and considerable hardship to several well owners. By November water levels in the aquifer had recovered, largely in response to the cessation of irrigation pumping. Legislation passed by the General Assembly and implemented in early 1982 created special guidelines for well construction and pumps in the 2 counties. It also provided for a complaint procedure so that the owner of a well that was constructed according to the guidelines, who experienced excessive lowering of well water, could ask for an emergency declaration by state officials and for restrictions to be placed on large users of water in the area. The guidelines recognized that heavy use of water would result in some drawdown of water levels in nearby wells and that all installations should be designed to handle some drawdown. Impact on water quality was also debated.

Implicit in the new law was the notion that users should share the water resource but that heavy users (like irrigators) could only use water from the aquifer up to the point where it began to cause "unreasonable hardship" for others. Also, high capacity wells capable of producing 100,000 gallons or more per day have to be "registered" with the Department of Natural Resources and data furnished about them.

The 1982 "Water Rights: Emergency Regulation" bill was a step toward more definitive water rights legislation

and an immediate response to a specific problem. But it was a limited response in that 1. it set up an "emergency" procedure only, and it did not necessarily prevent water allocation problems; 2. it applied only to ground water; and 3. it applied only in 2 counties of the state. Further, many owners of the small, domestic wells were not satisfied with the legislative solution and sought relief in court.

With the strong possibility of increased irrigation there will likely be more allocation problems in the near future, some of which may involve surface water and interbasin transfers. Future farm product prices and energy costs will affect irrigation expansion, as well as water availability.

Energy Production

The subject of energy has been widely discussed since the so-called "energy crisis" in the mid-1970's was brought on by the threat of foreign oil cutoffs, rapidly escalating petroleum prices, and dwindling reserves. While the early 1980's have seen a partial return to "normal" supply and demand relationships for energy resources, there are a number of factors that will encourage increased energy production in the midwest. Energy production is tied both directly and indirectly to water consumption.

Most signs point to a partial transition from petroleum and natural gas to other energy sources such as coal, biomass, and solar; only the speed and timing of the transition is in doubt. Indiana lacks petroleum energy resources relative to energy demand and must import vast quantities of energy to run its heavy industries and agriculture. Even with large amounts of coal and some oil and natural gas, we are one of the most energy-dependent states. A move toward self-sufficiency in energy production could be beneficial to the state's economy, both in terms of reducing the flow of dollars out of the area to energy suppliers and in terms of attracting economic development.

We will divide our discussion of energy production and water resource problems into 4 different aspects: 1. electric power generation from coal, 2. coal processing, 3. hydro-electric power, and 4. potential oil shale development and coal gasification.

Coal-Electric Power Generation. About 99 percent of electrical energy needs in Indiana are supplied by coal-fired generating plants. These coal-fired steam boilers use large quantities of water for cooling purposes and are located on or near major rivers and lakes. There is a great variation in how much water is actually consumed or "used up" as opposed to being returned to the source, depending on the cooling method used.

Of the 37 plants operating in the late 1970's, all but six used the "once through" or "cooling lake" method of water cooling that returns most of the water withdrawn. The "cooling tower" method disperses heat by evaporation and thus consumes water at a high rate. Future

generating plants will likely make use of cooling tower technology and will be larger than present day plants. Thus by the year 2000, the amount of water withdrawn for cooling purposes and later returned will go down, but the amount consumed will go up dramatically (see Table 1). Construction of generating capacity is projected to go up about 5 percent a year to the year 2000.

The questions raised by these potentially large consumptive uses include the impact on other users, the maintenance of stream flows, and the security of water withdrawal rights over time.

Coal Processing. Indiana coal production averaged about 22 million tons a year in the 1970's and went up slightly in the early 1980's. Over the long term our coal production is expected to rise considerably as petroleum reserves diminish and natural gas prices rise.

The coal production process uses water primarily for coal washing, with close to 80 percent of all coal processed to remove pyritic sulphur and ash. Not all the water used in coal preparation is consumed; much is recycled. Some water is used in land reclamation to establish cover following strip mining.

If we assume no new technology that will change water requirements, the future use of water in coal processing will be a function of quantity produced. Production estimates run from an increase of 50 percent by the year 2000 to a doubling of coal output by then. The Water Resources Study Commission predicts water consumption by the coal industry will go from about 15 millions of gallons per day (mgd) in 1985 to about 31 mgd in the year 2000, a substantial increase.

Hydroelectric Power. The use of water power to generate electricity involves an instream use of water, quite different from consumptive withdrawal uses we have been discussing. Instream uses do not diminish the supply of water and usually have little impact on water quality. This, plus the fact that Indiana has relatively flat topography and low-flow streams that minimize power generation potential, means hydroelectric power does not have a heavy impact on water supplies. But 3 fairly recent developments have brought renewed interest in water power: 1. the rapid increase in the cost of electricity from conventional generators, 2. the development of small-scale hydropower technology, and 3. government policies that encourage renewable energy production.

At present hydroelectric power is generated at only 5 sites in the state, representing less than 1 percent of our total generating capacity. In the early 1900's over 30 installations on the St. Joseph, Elkhart, Pigeon, Maumee, White, and Big Blue Rivers, and the Whitewater Canal supplied a significant portion of our electricity.

Reductions in construction, fuel, operation, and maintenance costs for large central-station, steam-electric generating plants made many of the old hydropower facilities obsolete. In today's economic climate, however, the decentralized production of small amounts of hydropower

is becoming attractive.

Economic studies completed for the state in 1981 considered 20 different non-federal sites with high potential for hydropower production. Six of the 20 appeared to be feasible for development based on economic factors at that time. In addition, another 8 Federal dam sites could be developed with a positive cost/benefit ratio. In all 14 cases, existing dams would be used and, in a few instances, some of the remaining structures that were used for generators in the past. A total 60.5 megawatts (MW) of new power would feed into the existing network, bringing the total hydro-electric capacity to 168 MW.

The water policy-rights issues raised here include the preservation of a limited number of sites for future development, the maintenance of stream flows and reservoir levels, and the impact on other instream uses like recreation and navigation.

Oil Shale and Coal Conversion. Indiana has massive quantities of oil shale in the south central part of the state. The Department of Energy estimates we have 384,000 acres suitable for stripping, containing millions of barrels of oil. Two firms have been actively leasing land on a long-term basis, with the possible prospect of oil shale mining in the future.

Oil shale production would require large amounts of water in an area that is already very short of water. The Phillips Petroleum Co., one of the active leasing firms, estimates a 50,000 barrel/day output would require 12 mgd for mining, retorting, and reduction. The Southern Indiana Shale Oil Company, the other firm involved in leasing, believes that much of its water requirements can be obtained from the shale itself, within which large amounts of water are trapped. In any case, water planning and management will be crucial, when and if this industry develops.

Coal conversion to liquid or gaseous fuels is an even more "iffy" proposition, but syn-fuel technologies use huge amounts of water for cooling equipment, supplying hydrogen for combination with carbon, and for washing and waste treatment. A typical coal conversion plant could use 12 to 22 thousand gallons of water per minute to produce 250 million standard cubic feet of gas a day. This is equivalent to the amount of water presently used by the city of Evansville.

Large scale development of oil shale or coal conversion is not anticipated in the immediate future, given petroleum prices at early 1980 levels. In both cases our concern is with the long-term energy needs of a state highly dependent on imported oil. The energy situation could change very quickly, even in the immediate future, and over time escalating petroleum prices seem inevitable as world reserves are used up. Coal and oil shale may be exploited in the western states before the midwest due to somewhat higher yielding material, lower sulphur content, and lower land and mining costs. But those states lack a crucial production factor that we have in greater abundance—water.

Nuclear-Electric Power Generation. One of the biggest unknowns in the electric power generation picture is the place of nuclear plants. Indiana has no operating nuclear generator at present, and with the halting of construction of the Bailey plant in the north and of Marble Hill along the Ohio River, it is hard to predict the future for this controversial technology. The Marble Hill plant would have been one of the largest single consumers of water in the state, using perhaps 36.5 million gallons per day, comparable to the quantity used by several steel mills or a large irrigator.

Areas Short of Water

When we think of the supply and demand for water on a geographical basis across the state, two kinds of places cause concern: southern Indiana, where water has been in short supply for years, and a few urban centers, where population growth is outstripping the capability of the local water resource. The urban supply problem is not acute as yet, but does raise serious questions about water rights in the future. The more immediate problem, what has been called "water poverty," is dealt with here.

In the southern $\frac{1}{3}$ of our state the ground water resource is extremely limited, with the exception of a few river valleys that cut through the area in a general north-east to southwest direction (see Figure 1). Two relatively new man-made lakes have large water supply capacity and are owned by the state. Both Monroe and Patoka Reservoirs supply substantial amounts of water, either directly to cities in the case of Monroe or to a large regional water district in the case of Patoka.

The major water supply problem occurs in the municipalities and rural areas which are some distance from the large river valleys and the two reservoirs. Extensive rural water systems have been built in the area, but many systems are approaching the limits of reasonable distance from their source of supply and lack capacity for much expansion. Many small communities are struggling with supply developments that are only marginally adequate for present needs and may limit economic development in the future.

Water supplies are extremely scarce in a number of rural areas where farm ponds and water delivery trucks are used to supply minimal quantities. Population is sparse and scattered, making it uneconomical to extend rural water systems across miles of terrain. For most of this area, water supply is being provided either from surface impoundments or by the importation of ground and/or surface water from other areas.

The major cities of southern Indiana are somewhat better off than isolated rural areas in terms of water availability. About half of the total public water supply withdrawals were accounted for by Evansville, Bloomington, Columbus, Bedford, Vincennes, Clarksville, and New Albany. Evansville alone accounts for 50 percent of the usage of the 7 largest cities and about $\frac{1}{4}$ of the region's total withdrawals.

The region contains a large number of electrical gener-

ating plants on the Ohio, the Wabash, White, West Fork of White River, and on the Patoka River. Considerable expansion of generating capacity is planned, assuming stream flows are maintained at near present levels.

Irrigation is important in scattered areas and depends largely on surface water. Acreage under irrigation is expected to double by the year 2000, with somewhat more dependence on ground water in the future. Irrigation is a consumptive use and could become the second largest user of water in the south, next to energy production. The region has few large water using industries compared to the industrial northwest. But as noted earlier, both increased coal production and potential oil shale development would also influence the area's water resource.

The water rights problems posed by the southern Indiana situation revolve around the many instances of transport and use of surface water from riparian lands and outside the basin of origin, and the use of ground water from overlying lands away from the basin in which the aquifer is located. There is no basis in law for this widely prevalent practice that has grown out of custom and tradition, no certainty of rights to use over time, and no way of allocating a resource that may become more scarce.

IV: POLICY PROPOSALS

The point being made here is that while water is generally plentiful, there are the beginnings of problems in specific areas of the state. The issue centers around water rights and managing a resource that must serve a variety of competing needs.

General Approaches

There are a number of general approaches that the state could follow. One obvious approach is to continue on as we are under the common law doctrine as enunciated by the courts. Few restrictions would be placed on any user, only those now recognized in the doctrines explained earlier. Typically it takes a crisis such as a major water shortage or threatened loss to create the climate for a basic change in water law. Policymakers need considerable motivation to move into this complex and controversial area. Changes come hard.

A second approach might entail what has been called a *property rights-institutional approach* that makes minor modifications in present law, but stops short of an administrative-public management approach. Water rights are still treated as belonging to individuals. Vague terms and concepts in common law could be clarified and the courts given more technical help in deciding cases. Local water districts might be created under new enabling legislation to carry out limited management functions.

A third approach could involve basic changes in water law that would lead to an *administrative-public management system*. This approach could range from a very

limited permit system affecting only a few large water users to a comprehensive management and allocation system. Here the state would take an active role in water management, under the assumption that water is ultimately the property of the state and that the state has a responsibility to ensure equitable and efficient use of a common property resource. The extent of management would depend on the perceived seriousness of water allocation problems.

Commission Proposals

The 2 water resource study commissions clearly favored the administrative-public management management approach in their recommendations. The "Governor's Water Rights and Management Commission—Report to Governor Orr, November 1982" gave this statement as part of the problem definition: "The existing law of water rights (basically the common law) is inadequate to provide that legal basis and management framework within which human, social, and economic needs for water may be satisfied in a timely and equitable manner. This conclusion is based upon the finding that: (a) The existing common law is directly concerned only with withdrawal uses by riparian owners in the case of surface water and by overlying landowners in the case of ground water. (b) It provides no basis in law for use on non-riparian and non-overlying lands, which in many areas is the major use and need, and is a widely prevalent practice throughout the state. (c) It provides no certainty of rights to use, regardless of the type of use or the investments to take and utilize the water. (d) It provides no recognition for legitimate and necessary instream uses and needs. (e) It provides no basis for recognition of the interrelated nature of the various components of the water resource and the relative impacts of the user of various components. (f) The only recourse for conflict resolution is to the courts, where the constraints of present law and the narrow issues of a particular case preclude consideration of the full range of relevant factors. These findings and conclusions served to define the problems and issues to which the commission addressed itself in the development of a new system of water rights and management."

The Commission went on to draft legislation for introduction into the 1983 General Assembly, into what was called the "Water Resource Management Act." The key provisions of the Act included:

1. Vesting management authority in the Natural Resources Commission and placing a positive duty on them to aid prospective water users in securing adequate sources of supply.
2. Providing for a continuing inventory and planning for the resource.
3. Establishing minimum stream flows and ground water levels.
4. Establishing a permit system which is mandatory for all withdrawal uses in excess of 100,000 gallons per day and optional for smaller users. The permit system

would:

- a. Provide for protection of a reasonable level of low streamflow for instream uses and minimum ground water levels in aquifers to prevent water mining and damage to the aquifer.
 - b. Provide for "grandfathering" of all existing users, including provision for full capability of existing developed sources.
 - c. Provide for public notice and opportunity for hearing in the new permit process.
 - d. Provide for protection of developed sources of supply, including impoundments, well fields, and streams, against other uses.
 - e. Provide for the transfer of water from one area to another, with provisions for the present and future needs of the area of origin.
 - f. Provide for the equitable solution of problems of well interference.
 - g. Provide for definite duration of permits, with provisions for renewal subject to continued use in accordance with the current permit.
 - h. Provide for modification and transfer of permits.
5. Providing for development and implementation of a plan dealing with periods of serious water shortage.

The Commission also drafted "The Recreational Use of Streams Act" that clarified and expanded the availability of streams for general public boating and fishing.

Response to Commission Proposals

The recommendations of the two commissions are very comprehensive and would have far-reaching consequences. During public hearings held by the commissions and in the deliberations surrounding the legislative process, a number of concerns were expressed by various individuals and special interests. Farm groups and some local governmental units resisted the concept that the state should allocate water supplies in the absence of any widespread "crisis." Several business and industrial groups questioned the need for a permit system but endorsed the idea of a water resource inventory and reporting system. Business and industry were more concerned over the immediate impact of additional regulations on economic development than on the possible gains from security of water rights over the long run.

A number of statewide interest groups did support the concept of a comprehensive allocation system, but not enough support developed to push the major new proposals through the legislature. What finally passed in 1983 was an act that provided for a water resource inventory that could lead to the establishment of minimum surface water flows and ground water levels and for the registration of "significant water withdrawal facilities." This registration procedure would not involve permits, but would be largely for informational purposes.

Other Institutional Approaches

One of the underlying assumptions in the commission studies, a concept embodied in subsequent legislative pro-

posals, is that the state has in effect a single water resource composed of interrelated elements that work closely together. Because of this, it is believed that a closely integrated comprehensive approach to water problems is needed that covers all the critical elements. Further, it is argued that only the state can administer such a program, both in terms of the jurisdictional authority needed and in terms of expertise and technical resources.

Counter arguments contend that we do not have an overall statewide problem in water, but rather a few emerging problems in specific geographic areas and/or in special water uses. The possibility is raised that local or regional institutional arrangements could be used to solve specific problems. The restraint of rules and regulations would be felt only where needed and program costs minimized. It is argued that control of water should remain as "close to home" as possible. New home rule provisions passed in recent years have also expanded possibilities for local units to exercise more options.

Two kinds of local approaches could be used within present legislation. County commissioners and city and town officials might adopt and enforce ordinances and regulations to control the location, construction, or repair of wells located in their jurisdictions, for example. Local officials have been hesitant to use these powers due to lack of local technical advice and monitoring capability, but provisions for such help might be made with appropriate state agencies. Local units could put together all kinds of water supply corporations, but of course subject to all the doubts and uncertainties expressed earlier.

A second local or regional approach would be to use a general purpose conservancy district, using provisions of the 1957 Act. Conservancy districts could be used for many of the functions we have mentioned, including securing and supplying water for irrigation, general water supply, and storage of water for augmentation of stream flow. Interested citizens can petition the circuit court to establish a district, which must also be approved by the Natural Resources Commission. A conservancy district would have a wide range of powers necessary to discharge its responsibilities, including powers of taxation, assessment, contracting, eminent domain, sale of services, etc.

Very likely there are several institutional alternatives at the local and regional level that remain to be considered. The uncertainty of water rights and our lack of experience with liberalized home rule create both opportunities to explore new approaches and difficulty in predicting what is legally feasible.

Unresolved Issues

Some specific water use issues are far from resolved and are likely to be the subject of public policy discussions in the near future. Three interrelated issues are focused on here.

Irrigation—The use of ground water for large scale irrigation in northwest Indiana and the subsequent lower-

ing of water levels in an extensive aquifer are the early warning signals of a developing problem. Some drawdown must be expected from irrigation, and the aquifer appears to be recharged in the fall and winter months. But these questions seem relevant:

1. How much drawdown is "fair" to other water users? What should be expected of the competing water users in terms of limiting their impact on the aquifer and their impact on each other?
2. What is a safe yield level of withdrawal, one that will allow the aquifer to recharge itself in a reasonable time and avoid "mining" the water?

3. If the problem persists, how can the conflicting interests be accommodated in an equitable and efficient manner?

Withdrawal Rights—The right to use water is very uncertain in terms of at least two dimensions:

1. Priority or preference of use is not clearly established. While small quantity, domestic use is usually favored and protected, other uses can and do interfere.
2. Security of rights over time is lacking. Land ownership or control is a necessary condition to secure water rights, but not a sufficient condition.

Water Transfer and Sale—Transfer of water from one basin or watershed to another is an apparent contravention of the common law. The extent of riparian lands is not known. The merchantability of water is open to question, especially by those whose right to it in the first place is questionable.

All these issues become more important when and if water resources become more valuable and scarce. Some issues will be decided in court, but most students of the subject feel that the courts are not the preferred place to decide complex issues of this kind. Persistent and serious conflicts need to be resolved by rule of law and/or in the marketplace.

Where are We Headed?

If we are correct in predicting that new and increasing water demands will put pressure on water supplies for certain uses and particular areas of the state, then we will continue to move away from custom and tradition determining water rights.

The western states faced up to water problems early in their history as water became an important limiting factor in their growth. The agricultural midwest is just now "feeling the pinch." The pattern of adjustment has often been as follows:

1. Perception of a problem and increasing appeals to the courts and the legislature.
2. Agreements on reform and conservation among competing users.
3. Protection and increased security of existing uses.
4. Authorization of inventory, reporting, and measuring programs.
5. Implementation of an allocation/permit system that affects large users and limits new uses.

6. Proposal and partial implementation of comprehensive management and planning programs.
7. Pursual of water supply augmentation if shortages are serious.

A combination of partial solutions and accommodations can come from different sources. Legislative action can clarify water rights and rules and create new institutions to administer water programs. The courts can ad-

judicate specific and narrow issues involving disputes between water users. New market arrangements can be created that aid in the pricing and costing of water so that it is put to its most valued uses.

The man-made problems of rights, management, transfer, and security can be solved to take care of the nature-made problems of water allocation. What is needed is the willpower and brainpower to get on with the job.

REFERENCES

- W. J. Andrews, "Water Resource Problems, Conflicts and Issues," Staff Paper, Indiana Dept. of Natural Resources, 1979.
- E. E. Carson, et al., "Irrigation of Field Crops in Indiana," ID-119, Cooperative Extension Service, Purdue University, 1979.
- D. E. Ditwiler, "Institutional Constraints and Economic Options—A Basis for Management Decisions in Intraregional Water Transfer," *Land Economics Journal*, May 1968, Vol. XLIV, No. 2, pp. 173-184.
- R. G. Heck and C. M. Larason, "Water Resources . . . as an Economic Tool," Proceedings of the Indiana Water Resources Assoc. Symposium, June 1982, pp. 89.
- A. C. Hoberg, "The Nature and Extent of Groundwater Management and Groundwater Problems: A Survey," *Agricultural Law Journal*, Vol. 4, No. 3, Fall 1982, pp. 404-442.
- M. E. Kelso, C. A. Martin, and L. E. Macks, *Water Supplies and Economic Growth in an Arid Environment*. Tucson 1973.
- M. C. Poland, "The Law of Water Rights," *The Indiana Water Resource*. Indiana Dept. of Natural Resources, 1980, pp. 91-124.
- E. C. Roberts, "Water Rights and Water Resources," Staff Report, State Planning Agency, 1981.
- Governor's Water Resource Study Commission, State of Indiana, *The Indiana Water Resource: Availability, Uses and Needs*. Indianapolis 1980.
- Governor's Water Resource Study Commission, State of Indiana, *The Indiana Water Resource: Recommendations for the Future*. Indianapolis 1980.
- Governor's Water Rights and Management Commission, "Report to Governor Orr and Recommended Draft Legislation," Indiana Dept. of Natural Resources, Nov. 1982.
- Indiana Dept. of Natural Resources, Division of Water, "Preliminary Report on Groundwater Levels in Jasper and Newton Counties," Investigation No. 18, Nov. 1982.
- Mittelhauser Corp. and Indiana Dept. of Commerce, "Assessment of the Hydropower Resource Development Potential in Indiana," Downers Grove, Ill. 1981.
- USDA, ERS, "Water Resources for Agriculture," Ag. Info. Bul. No. 384, Washington, D. C., April 1975.
- USDA, *Water, 1955 Yearbook of Agriculture*, Washington, D. C.

Historic Document

NEW 3/84 (2M)
Cooperative Extension Work in Agriculture and Home Economics, State of Indiana, Purdue University and U.S. Department of Agriculture
Cooperating. H. A. Wadsworth, Director, West Lafayette, IN. Issued in furtherance of the Acts of May 8 and June 30, 1914. It is the policy of the
Cooperative Extension Service of Purdue University that all persons shall have equal opportunity and access to its programs and facilities
without regard to race, color, sex, religion, national origin, age or handicap.

Historic Document